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FLOW-MODIFYING HEAT EXCHANGER CORE TUBES

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A heat exchanger (12) includes a first header (20) including a fluid inlet (28), a second header (22) positioned downstream of the first header with respect to a first internal fluid flow path (F1) of a first fluid and including a fluid outlet (30), and a core (24) extending from the first header to the second header. The core includes a plu-
- rality of flow-modifying core tubes (32) that are shaped, angled, and/or arranged to modify flow through the heat exchanger along a second external fluid flow path. The plurality of flow-modifying core tubes includes airfoil tubes (112) with corresponding airfoil cross-sections.

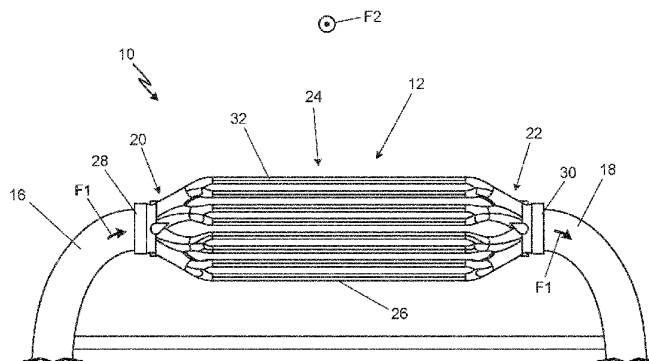


Fig. 1



EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S52 21447 U (UNKNOWN) 15 February 1977 (1977-02-15) * figures 1-4 *	1,2,5,6, 13	INV. F28F1/02 F02C7/14 F28D1/053 F28D21/00
X	JP 2010 256004 A (HAMILTON SUNDSTRAND CORP) 11 November 2010 (2010-11-11) * figures 1-5 *	1,2,5,6, 13	
X	WO 2022/152716 A1 (ASETEK DANMARK AS [DK]) 21 July 2022 (2022-07-21) * figure 5 *	1-9,13, 15	
X	FR 2 264 262 A1 (FONDERIE SOC GEN DE [FR]) 10 October 1975 (1975-10-10) * figures 1, 8, 9 *	1,2,5,6, 13	
			TECHNICAL FIELDS SEARCHED (IPC)
			F28F F02C F28D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 June 2024	Examiner Delaitre, Maxime
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1 - 9, 13, 15

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9, 13, 15

Heat exchanger comprising a core with airfoil shaped tube with improved aerodynamic geometries.

2. claims: 10, 14

Open volume heat exchanger comprising a core with airfoil shaped tubes.

3. claim: 11

Heat exchanger comprising a core with airfoil shaped tube manufactured by additive manufacturing

4. claim: 12

Heat exchanger comprising a core with airfoil shaped tube and fractal headers.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 24 15 7684

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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05-06-2024

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	JP S5221447 U	15-02-1977	NONE	
15	JP 2010256004 A	11-11-2010	FR 2944590 A1 JP 2010256004 A US 2010263847 A1	22-10-2010 11-11-2010 21-10-2010
20	WO 2022152716 A1	21-07-2022	EP 4030131 A1 WO 2022152716 A1	20-07-2022 21-07-2022
25	FR 2264262 A1	10-10-1975	NONE	
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